DCCUMENT BESUME

ED 153 824 SE 024 121

AUTHOR Epstein, Abraham H.; And Others
TITLE Iowa Commercial Pesticide Applicator Manual, Category 1D: Fruit and Vegetable Pest Control and Supplement. CS-12 and CS-12a.
INSTITUTION Iowa State Univ. of Science and Technology, Ames. Cooperative Extension Service.
PUB DATE Jan 77
NOTE 59p.; For related documents, see SE 024 120-133, SE 023 740 and SE 024 060-061; Supplement printed on colored paper and may not reproduce well

EDRS PRICE MF-$0.83 HC-$3.50 Plus Postage.
DESCRIPTORS *Agricultural Production; Certification; Entomology; *Environment; Herbicides; *Pesticides; Safety; *Weeds
IDENTIFIERS Iowa; *Pests

ABSTRACT

This manual provides information needed to meet specific standards for certification as a pesticide applicator. The major weed and insect pests of fruits and vegetables are pictured and discussed. Suggested methods for control by utilizing herbicides and pesticides are presented with attention given to safety considerations for both humans and the environment. The supplement provides information on diagnosing and controlling diseases of fruit trees and vegetables. (CS)

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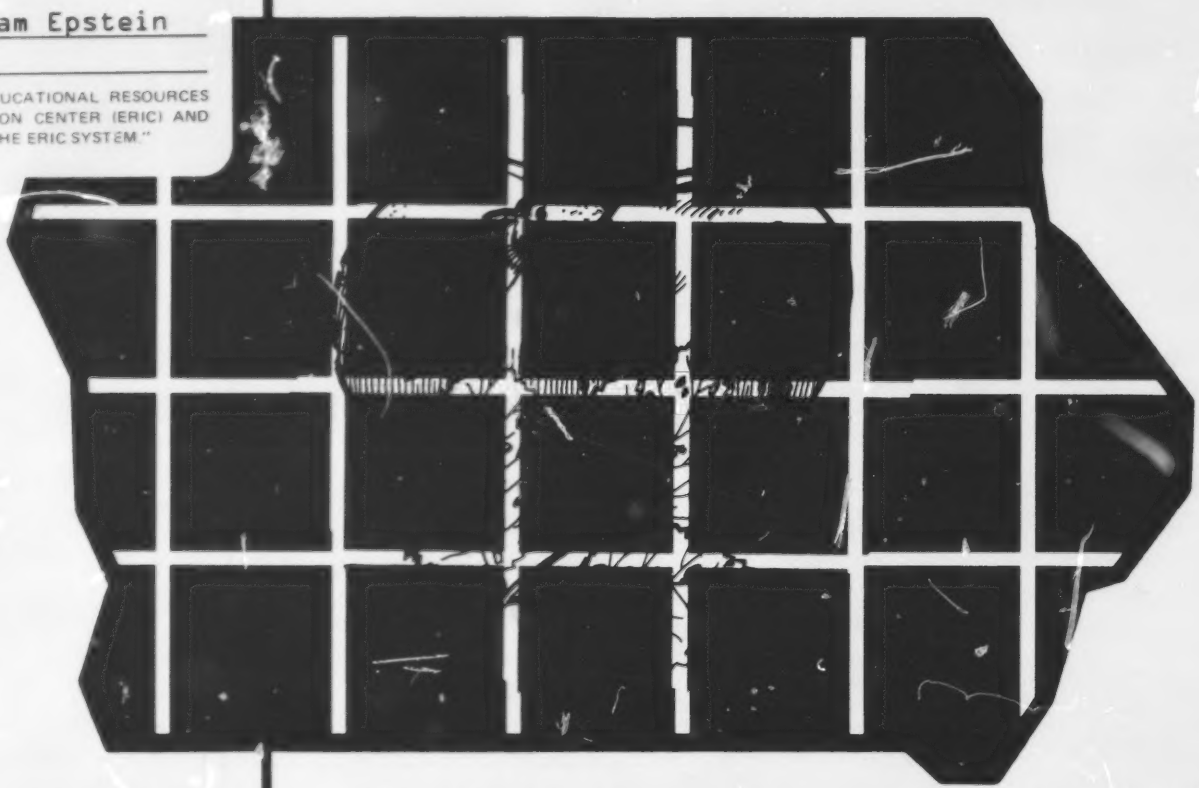
Iowa
Commercial Pesticide Applicator Manual

CATEGORY 1D

FRUIT AND VEGETABLE PEST CONTROL



This manual is to be used for certification training in conjunction with the U. S. Department of Agriculture – U. S. Environmental Protection Agency manual, **Apply Pesticides Correctly,** EPA-335.

Cooperative Extension Service
IOWA STATE UNIVERSITY
Ames, Iowa 50011

CS-12
January 1977

This manual has been developed for individuals wishing to become certified in commercial pesticide applicator category 1D, Fruit and Vegetable Pest Control. It contains specific information that an individual must know before becoming certified in category 1D. The manual has been designed to supplement the general information contained in the core manual, **Apply Pesticides Correctly—A guide for commercial applicators** (plus an Iowa State University supplement) and should not be used for certification preparation without referring to the core manual as well.

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Prepared by Abraham H. Epstein, extension plant pathologist, Richard S. Fawcett, extension weed specialist, Henry G. Taber, extension horticulturist, and Jerry R. DeWitt, pesticide training coordinator, who express appreciation to the University of Georgia, Michigan State University, and Purdue University for the use of source material.

CROP PRODUCTION

Modern, efficient agriculture produces crops on large, continuous acreages of land. Unfortunately, this type of agriculture encourages invasion of the crops by a wide variety of damaging pests. Therefore, production of these crops also requires the use of large quantities of pesticides in order to produce the quantity and quality of products needed for the continued well-being of man. The productiveness of modern agriculture is truly one of the marvels of our time, and it is probably the most important underlying factor that gives the United States the highest standard of living of any country in the world.

Agricultural crops may be divided into field and forage crops, vegetable crops, and orchard crops. The necessity of pesticides for maximum production of high quality products has been documented many times by research and experience. The quality of products grown without the use of pesticides is generally much lower and, in many instances, too poor to be accepted for market.

Proper care must be exercised in applying pesticides to any crop. Methods of application vary widely, with some being more dangerous to the applicator than others. For example, spraying orchard trees where the pesticide is applied above the head of the applicator is much more hazardous than applying chemicals to a low growing field or forage crop.

When planting crops, consideration should be given to the pesticides that will be used during the production season, the methods of application that will be employed, and whether either of these considerations presents any problem for adjacent, nontarget areas such as bodies of water, woodlands, urban areas and other crops that may become contaminated. Every effort should be made in planning to at least minimize these problems and prevent them if possible.

Changes in registrations of old pesticide products or new product registrations may occur before each cropping season. Carefully read the label before using any pesticide.

WEED CONTROL IN FRUITS AND VEGETABLES

Effective weed control in vegetable and fruit crops usually requires a combination of cultural and chemical methods. Growing the same crop year after year, using the same weed control techniques, will encourage the development of problem weeds. Rotation of crops, herbicide, or tillage methods can help solve this problem.

Although herbicides offer an effective and economical means of weed control, certain risks are inherent in their use. Crop injury is one of these risks. No crop plant is completely resistant to herbicide injury, but is able to tolerate a certain dosage. Selectivity, or the ability of a herbicide to kill weeds without harming crop plants, is dependent on proper application method, time, rate, and numerous other factors. Selectivity may be partially lost due to unfavorable weather conditions. Herbicide label directions must be followed carefully to avoid crop injury and to obtain maximum weed control.

Methods of Herbicide Application

Preplant incorporated. Certain herbicides must be incorporated into the soil after application. Some volatilize or evaporate into the air if they are not incorporated. Others photodecompose or break down in sunlight unless incorporated. Some herbicides may either be incorporated or applied to the soil surface. Incorporation may provide more dependable weed control in dry weather or give better control of specific weed problems.

Preemergence. Preemergence herbicide treatments are applied to the soil surface after planting and before crops or weeds emerge. Surface moisture must follow surface treatment for most soil applied herbicides to be effective. You will obtain best results when these herbicides are carried into the soil by rainfall or overhead irrigation.

Postemergence. Postemergence herbicide treatments are applied to the foliage of plants. They may burn off the tops of weeds (contact herbicides) or they may be transported throughout the plants and kill underground parts (translocated or systemic herbicides). The latter type of chemical is particularly useful for controlling perennial weeds. Many postemergence herbicides are most effective when applied to small, actively growing weeds.

Some postemergence herbicides are applied as directed sprays. Here, selectivity is obtained by spraying only weeds and keeping the spray off of the crop.

Herbicides as Affected by Soil Type

Many herbicides are absorbed by soil colloids (clay and organic matter particles). This reduces the amount of herbicide available in the soil to kill weeds (or to cause injury to crop plants). For this reason, rates of soil applied herbicides often vary according to soil type. In general, lower rates are needed on sandy (coarse textured) soils than are needed on clays or mucks (fine textured soils). Some herbicides

may be completely inactivated by the very high organic matter content of muck soils. Soil pH may also influence the relative activity of a soil applied herbicide.

Soil type also influences the degree to which a herbicide leaches (moves through the soil profile with water). Herbicides leach more readily in sandy soils than in more fine textured soils. The degree of leaching also depends on the relative water solubility of the herbicides. Selectivity of certain herbicides is dependent on the herbicide remaining in the surface layers of the soil. Using such a herbicide on a coarse textured soil could result in crop injury or reduced weed control.

MAJOR WEEDS IN FRUIT AND VEGETABLE CROPS

(see illustrations and information on following pages)

COMMON NAME	SCIENTIFIC NAME	OTHER COMMON NAME
BROADLEAF WEEDS		
Bindweed	*Convolvulus spp.*	Field and hedge bindweed, creeping jenny, pea vine
Black nightshade	*Solanum nigrum*	
Carpetweed	*Molugo verticillata*	
Cocklebur	*Xanthium stumarium*	
Common milkweed	*Asclepias syriaca*	
Giant ragweed	*Ambrosia trifida*	Horseweed
Common smartweed	*Polygonum persicaria*	Ladysthumb
Common ragweed	*Ambrosia artemisiifolia*	Ragweed, small ragweed
Jimsonweed	*Datura stramonium*	
Lambsquarters	*Chenopodium album*	
Morning glory	*Ipomoea spp.*	Includes tall or annual and ivy leaved
Pennsylvania smartweed	*Polygonum pensylvanicum*	
Pigweed	*Amaranthus spp.*	Redroot pigweed, rough pigweed, also smooth pigweed and hybrids
Purslane	*Portulaca oleracea*	Pusely
Sunflower (annual)	*Helianthus annuus*	
Velvetleaf	*Abutilon theophrasti*	Buttonweed, butter print
Venice mallow	*Hibiscus trionium*	Shoofly, flower-of-an-hour
GRASSY WEEDS AND SEDGES		
Barnyard grass	*Echinochloa crusgalli*	
Fall panicum	*Panicum dichotomiflorum*	Panicgrass
Giant foxtail	*Setaria faberii*	
Green foxtail	*Setaria viridis*	Includes many hybrids, robust white and purple
Large crabgrass	*Digitaria sanguinalis*	
Quackgrass	*Agropyron repens*	
Sandbur	*Cenchrus pauciflorus*	Burgrass
Witchgrass	*Panicum capillare*	
Yellow foxtail	*Setaria lutescens*	Pigeon grass
Yellow nutsedge	*Cyperus esculentus*	Nutgrass

MAJOR WEEDS IN FRUIT AND VEGETABLE CROPS

BROADLEAF WEEDS

FIELD BINDWEED, Creeping jenny, Small morning glory *(Convolvulus arvensis)*. **1**, plant in flower; **2**, seed pod, entire and in cross section; **3**, seed; **4**, variations in leaf shape. **Perennial**, reproducing by seeds and rootstocks.

HEDGE BINDWEED *(Convolvulus sepium)*. **1**, plant in flower; **2**, seed; **3**, seed pod; **4**, variations in leaf shape. **Perennial**, reproducing by seed and fleshy creeping rootstocks.

BLACK NIGHTSHADE *(Solanum nigrum)*. **1**, entire plant; **2**, berry; **3**, flower. **Annual**, reproducing by seed.

COCKLEBUR, Clotbur *(Xanthium pennsylvanicum)*. **1**, upper part of plant; **2**, seed; **3**, bur; **4**, seedling plant. **Annual**, reproducing by seed.

COMMON MILKWEED *(Asclepias syriaca).* **1,** lower part of stem and rootstock; **2,** upper part of stem with flower clusters and seed pods. **Perennial,** reproducing by seed and from long spreading rootstocks.

GIANT RAGWEED, Horseweed, Kinghead *(Ambrosia trifida).* **1,** portion of stem showing leaves and flowers; **2,** seed. **Annual,** reproducing by seed.

LADYSTHUMB, Common Smartweed *(Polygonum persicaria).* **1,** upper part of plant; **2,** section of stem, leaf, and leaf sheath; **3,** seed. **Annual,** reproducing by seeds.

COMMON RAGWEED *(Ambrosia artemisiifolia).* **1,** plant; **2,** seed.

PURSLANE, PUSLEY *(Portulaca oleracea)*. **1,** entire plant showing fleshy stems, prostrate growth habit; **2,** flower; **3,** pods; **4,** seed. **Annual,** reproducing by seed.

CARPETWEED *(Mollugo verticillata)*. **1,** small plant, showing habit of growth; **2,** flower; **3,** young seed-pod in calyx; **4,** seed. **Annual,** reproducing by seed, with little-branched taproot.

JIMSON WEED *(Datura stramonium)*. Upper portion of plant. **Annual,** reproducing by seed.

LAMBSQUARTER *(Chenopodium album)*. Roots, leaves and flowers. **Annual,** reproducing by seeds.

IVY-LEAVED MORNING GLORY *(Ipomoea hederacea).* **1,** Portion of plant. **Annual,** reproducing by seed.
ANNUAL MORNING GLORY *(Ipomoea purpurea)* **2,** leaf

PENNSYLVANIA SMARTWEED *(Polygonum pensylvanicum).* **1,** lower part of plant; **2,** upper part of plant. **Annual,** reproducing by seeds.

ROUGH PIGWEED, Redroot *(Amaranthus retroflexus).* **1,** lower stem and roots; **2,** upper stem with leaves and flower clusters. **Annual,** reproducing by seeds.

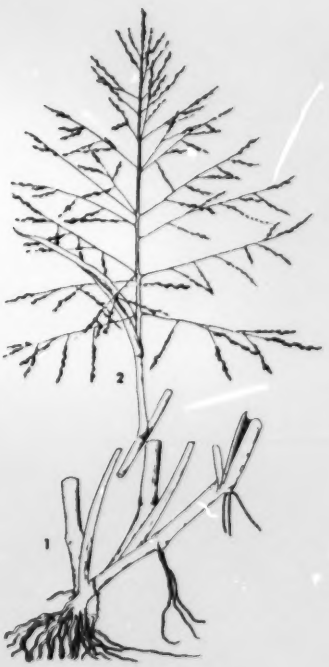
SUNFLOWER *(Helianthus annuus).* **1,** upper stem with flowers; **2,** lower stem and root system. **Annual,** reproducing only by seed.

VELVET LEAF, Indian mallow, Butter print *(Abutilon theophrasti)* **1**, root; **2**, upper part of stem with flowers. **Annual.**

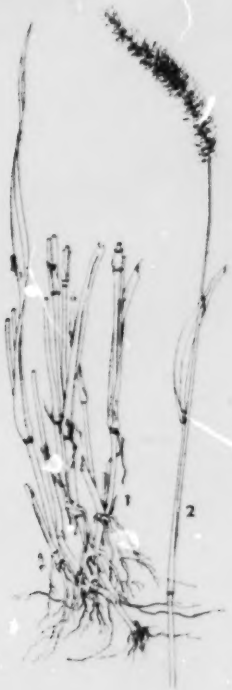
VENICE MALLOW, Flower-of-an-hour *(Hibiscus trionum).* Entire plant. **Annual,** reproducing by seed.

GRASSY WEEDS AND SEDGES

BARNYARD GRASS *(Echinochloa crusgalli).* Plant. **Annual** with fibrous, rather shallow roots.



FALL PANICUM, Spreading panicgrass *(Panicum dichotomiflorum).* **1**, lower part of plant showing root system; **2**, panicle. **Annual** with fibrous roots, reproducing by seeds.



GIANT FOXTAIL *(setaria faberii)*. **1**, lower part of plant; **2**, stem with panicle. **Annual**, reproducing by seed.

GREEN FOXTAIL, Green bristlegrass *(Setaria viridis)*. Entire plant. **Annual**, similar to giant foxtail but smaller, growing 1 to 3 feet tall.

LARGE CRABGRASS, Large hairy crabgrass *(Digitaria sanguinalis)*. Entire plant. **Annual**, reproducing by seed.

QUACKGRASS, Couchgrass *(Agropyron repens)*. Stems, leaves, and inflorescence. **Perennial**, reproducing by seed and underground rootstocks.

SANDBUR, Burgrass *(Cenchrus pauciflorus).* **1,** mature plant showing burs in terminal spikes; **2,** bur; 3, a single seed from a bur. **Annual,** reproducing by seed.

WITCHGRASS, Tumble panicgrass *(Panicum capillare).* Entire plant. **Annual** with fibrous roots, reproducing by seeds.

YELLOW NUTSEDGE *(Cyperus esculentus).* **1,** whole plant; **2,** seed. **Perennial,** reproducing by seed and tubers on roots.

YELLOW FOXTAIL, Pigeon grass *(Setaria lutescens).* Entire plant. **Annual,** reproducing by seeds.

This information included for your information; it is not required for certification.

Herbicides Registered for Use in Fruit and Vegetable Crops

Herbicide	apples	asparagus	beets	broccoli	snap beans	cabbage	cantaloupe	carrots	cauliflower	cherries	cucumbers	grapes	onions	peaches	peas	peppers	plums	potatoes	pumpkins	raspberries	squash	strawberries	sweet corn	sweet potatoes	tomatoes	watermelon
Aatrex (atrazine)																							X			
Alanap (naptalam)							X				X															
Amiben (chloramben)					X											X			X		X			X	X	
Ammate (ammonium sulfamate)	X																									
Bladex (cyanazine)																							X			
Casoron (dichlobenil)										X																
2,4-D	X	X																					X			
Dacthal (DCPA)				X		X			X				X					X				X		X		
Dowpon or Basfapon (dalapon)	X	X													X			X					X			
Enide (diphenamide)																X						X		X	X	
Eptam (EPTC)					X													X								
Eradicane (EPTC + R-25788)																							X			
Furloe (chlorpropham)								X					X													
Karmex (diuron)	X	X																								
Lasso (alachlor)																							X			
Lorox (linuron)								X										X								

(continued)

Herbicides Registered for Use in Fruit and Vegetable Crops (cont.)

Herbicide	apples	asparagus	beets	broccoli	snap beans	cabbage	cantelope	carrots	cauliflower	cherries	cucumbers	grapes	onions	peaches	peas	peppers	plums	potatoes	pumpkins	raspberries	squash	strawberries	sweet corn	sweet potatoes	tomatoes	watermelon
Maloran (chlorbromuron)																		X								
MCPA															X											
MCPB															X											
Paraquat	X									X				X												
Prefar (bensulide)							X				X															X
Premerge or Sinox (dinoseb)					X										X			X								
Princep (simazine)	X	X								X		X								X			X			
Pyramin (pyrazon)			X																							
Ramrod (propachlor)															X								X			
Randox (CDAA)													X										X			
Ro-Neet (cycloate)			X																							
Roundup (glyphosate)	X									X													X			
Sinbar (terbacil)	X													X												
Stoddard Solvent (petroleum solvent)								X																		
Sutan+ (butylate + R-25788)																							X			
Tenoran or Norex (chloroxuron)								X														X				

(continued)

Herbicides Registered for Use in Fruit and Vegetable Crops (cont.)

Herbicide	apples	asparagus	beets	broccoli	snap beans	cabbage	cantelope	carrots	cauliflower	cherries	cucumbers	grapes	onions	peaches	peas	peppers	plums	potatoes	pumpkins	raspberries	squash	strawberries	sweet corn	sweet potatoes	tomatoes	watermelon
Tolban (profluralin)					X																					
Tok (nitrofen)				X		X		X	X				X													
Treflan (trifluralin)				X	X	X		X	X						X	X									X	
Vegedex (CDEC)				X	X	X	X		X		X												X		X	X
Vegeben (chloramben methylester)					X		X				X															
Sencor or Lexone (metribuzin)																		X								

Refer to Weed Control in Commercial Vegetables and Fruits, Iowa State University Extension Bulletin FG-600 for application methods, rates, cautions, and limitations.

This information included for your information; it is not required for certification.

RELATIVE EFFECTIVENESS OF SELECTED HERBICIDES FOR WEED CONTROL IN FRUIT AND VEGETABLE CROPS*

This material is included for your information only; it is not required for certification.

G=Good F=Fair P=Poor N=None

	Barnyardgrass	Crabgrass	Fall Panicum	Foxtail (spp.)	Yellow Nutsedge	Annual Morning Glory	Jimsonweed	Lambsquarters	Pigweed	Purslane	Ragweed	Smartweed	Velvetleaf
PREPLANT INCORPORATED													
Enide	G	G	G	G	N	N	N	F	G	F	P	F	N
Eptam	G	G	G	G	F	P	N	F	G	-	P	P	F
Prefar	G	G	G	G	N	N	N	G	F	F	N	N	N
Treflan	G	G	G	G	N	F	P	F-G	G	G	P	F-F	N
PREEMERGENCE													
Alanap	-	F	-	F	F	N	F	G	F	F	G	P	F
Amiben	G	G	F	G	N	N	F	G	G	G	G	F-G	F
Maloran	F-G	F-G	F-G	F	N	P	G	G	G	G	G	G	G
Dacthal	G	G	-	G	N	N	P	G	F	G	N	N	N
Dymid or Enide	G	G	G	G	N	N	N	F	G	F	N	F	N
Lasso	G	G	G	G	F	N	P	F	G	G	P	P	N
Karmex	G	G	G	G	N	G	G	G	G	G	G	G	G
Lorox	F	F	F	F	N	P	G	G	G	G	G	G	G
Prefar	G	G	G	G	N	N	N	F	F	F	N	N	N
Premerge or Sinox PE	F	F	P	F	N	P	G	G	G	G	G	F	F
Princep (Simazine)	F	F	F	F	P	G	G	G	G	G	G	G	F
Randox	F	G	P	F	N	N	N	F	G	G	P	P	N

Herbicide Effectiveness—Fruits & Vegetables (cont.)

	Barnyardgrass	Crabgrass	Fall Panicum	Foxtail (spp.)	Yellow Nutsedge	Annual Morningglory	Jimsonweed	Lambsquarters	Pigweed	Purslane	Ragweed	Smartweed	Velvetleaf
PREEMERGENCE (cont.)													
Sinbar	G	G	G	G	P	-	G	G	F	G	G	G	G
Tenoran or Norex	F	F	F	F	N	G	F	G	G	G	G	G	P
Vegadex	F	F	F	F	N	P	P	F	F	G	-	-	P
POSTEMERGENCE													
Chloro IPC + Randox	G	G	-	G	N	-	-	F	G	G	P	G	-
Lorox	G	G	G	G	P	G	G	G	G	G	G	G	G
Premerge or Sinox PE	P	P	P	P	N	G	G	G	G	G	G	G	G
Stoddard solvent	G	G	G	G	P	G	G	G	G	G	N	G	G
Tenoran	-	P	-	P	N	G	F	G	G	G	F	G	P
Tok	F	F	-	F	N	G	G	G	G	G	N	G	G

This chart should be used only as a guide. Ratings of chemical may be higher or lower than indicated depending on soil conditions, managerial factors, environmental variables and rates applied.

*Adapted from WEEDING WITH CHEMICALS - 1975 GUIDE, Purdue University.

FRUIT AND VEGETABLE INSECT CONTROL

Insects are the most abundant form of animal life on the face of the earth. There are far more different species (kinds) of insects than all other animals combined. Relatively few of these different species of insects are considered to be economically damaging to agricultural plants. Species of beneficial insects outnumber damaging species.

Often damaging insects attack crops and many of them are capable of completely destroying the crop they infest. When damaging infestations occur, they must be controlled if losses are to be prevented. The most important step in dealing with an insect problem is identifying the pest or pests involved. Once the insect is identified, information on its life cycle and habits, as well as the best methods of control, can be obtained.

The most useful tool in controlling damaging populations of insects in crops is chemical insecticides. However, the overuse of insecticides may cause problems. Some insect and mite species have become resistant to once effective and widely used insecticides. In addition, the overuse and inappropriate use of insecticides may deplete or eliminate parasitic or predatory insect and mite populations, thus creating the need for more use of insecticides. Insecticides should be used only when and where they are needed. Insecticides should be thought of as production tools and used only when economic insect populations are likely to exist or when insect populations are increasing and crop yields will be reduced if the populations are not suppressed.

MAJOR INSECTS ON VEGETABLES

More than 60 insects can be pests on vegetables grown in Iowa. Few, however, become serious problems. The insects listed below are the more common pests that could be encountered on most vegetables.

APHIDS

Aphids are small, green or dark insects that cluster on stems or under leaves and suck plant sap. Numerous generations are present each year on various vegetables. Damaged leaves curl and thicken or plants become yellow and unthrifty.

BEAN LEAF BEETLES

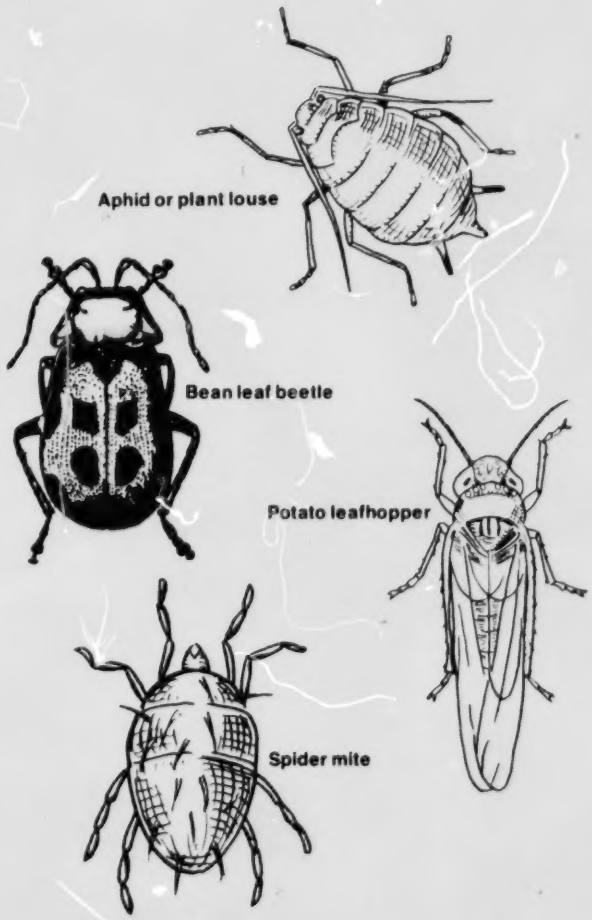
Adult beetles are ¼-inch long and reddish-yellow with black spots on the back. Beetles eat regular-shaped holes in leaves.

LEAFHOPPERS

Several species of ⅛-inch long, green wedge-shaped insects attack numerous vegetables. Nymphs resemble adults and suck sap from leaves, stems, and vegetables. Damaged plants turn yellow and may be stunted or die.

SPIDER MITES

Several species of extremely tiny pests are found on undersides of leaves. Nymphs and adults suck sap from leaves. Damaged plants exhibit yellow specks on leaves and fine webs.



FLEA BEETLES

Adults, black, brown, or striped beetles about 1/16-inch long, jump when disturbed. Young plants heavily damaged. Leaves appear as if they have been shot full of holes.

Potato flea beetle

CABBAGE LOOPER

Loopers are 1½-inch long, pale-green worms with light stripes down back. They double up or loop when crawling. Loopers feed on undersides of leaves producing ragged holes and may burrow into cabbage heads.

Cabbage looper or inchworm

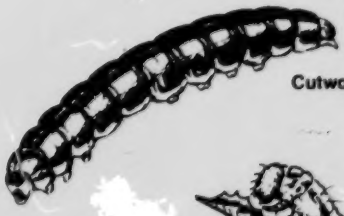
IMPORTED CABBAGEWORM

Cabbageworms are 1¼-inch long, velvety green larvae. Adults are white butterflies. Damage is similar to cabbage loopers.

Imported cabbageworm

CUTWORMS

Many species of 1¼-inch long, dull gray, brown or black larvae that may be spotted or striped. They are stout, soft-bodies, and smooth and curl up tightly when disturbed. Damage is done by feeding on stems below ground or cutting plants at soil level. Some feed on leaves, buds, or fruits. Damage is usually most severe in early spring.



Cutworm

CORN EARWORMS

Moths fly to Iowa in late spring-early summer. Eggs are laid on silks. Green, brown, or pink 1¾-inch long larvae with light stripes feed on fruit or ear tips.

Corn earworm

HORNWORMS

Several species of large green, robust worms with light diagonal stripes and prominent horn on rear end. They feed on fruit and foliage of tomato and other vegetables.

Tomato hornworm

COLORADO POTATO BEETLE

Yellow with black striped adults up to ⅜-inch long and brick-red larvae feed on foliage of potato and other vegetables. They are especially destructive to small plantings.

Potato beetle or potato bug

SEED CORN MAGGOTS

Maggots are yellowish-white, legless and ¼ to ⅓-inch long. They bore into sprouting seeds. They are most damaging in cool, wet soil to early planted seed.

Seed-corn maggot

WHITE GRUBS

Several species of ½ to 1½-inch long white or light yellow larvae with dark heads are found attacking vegetables. Larvae are curved or C-shaped. Grubs live in the soil from 1 to 3 years. Damage is done to roots and underground tubers. Adults are beetles that feed on foliage of trees.

CUCUMBER BEETLES

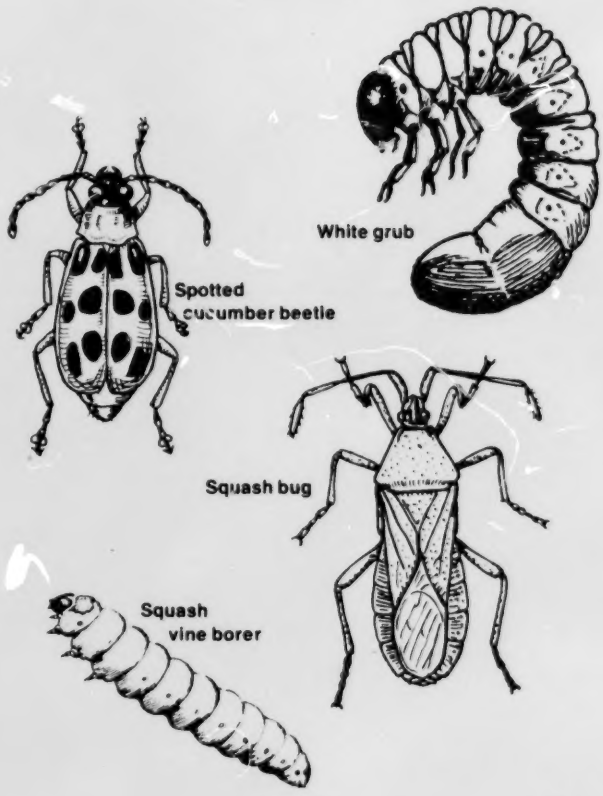
Yellowish-green, ¼-inch long beetles with black spots or stripes frequently feed on stems, leaves, and fruit of curcubits. Adults are vectors of bacterial wilt. Larvae feed on roots. Damaged plants wilt and die.

SQUASH BUGS

Adults are ⅝-inch long brownish, flatback bugs. Nymphs vary from bright green with red head and legs to dark greenish-gray with black legs and head. Adults and nymphs feed in colonies and suck sap from leaves and stems. Plants wilt and die.

SQUASH VINE BORER

Pupae overwinter in soil. White larvae up to 1-inch long bore into vines. Runners wilt. Fruits may also be attacked.



Pesticide Applicator Responsibilities

Commercial vegetable growers in Iowa must control insect pests if they desire to produce vegetables profitably at maximum efficiency and minimum cost. The Iowa Consumer will not accept blemished or insect-damaged vegetables. Today's pesticides enable the grower to supply quality produce to the consumer. Careful use of pesticides on vegetables does not present undue risks for either the producer or the consumer. Responsible growers should:

1. Carefully read and understand the label before applying any pesticide on vegetables.
2. Follow label recommendations for mixing and application rates.
3. Treat only when necessary.
4. Maintain accurate records of pesticide use.

Integrated Concepts of Control

Although pesticides are a necessary tool in controlling insects on vegetables, the total management of the insect problems should be based on sound, integrated concepts on a yearly basis. Insecticides will not eradicate all insects. The following measures should be integrated into your total pest management program:

1. Maintain fertile, well-drained soil for optimum growing conditions. Water regularly if applicable.
2. Plant vegetables that are best suited to the soil and climate.
3. Practice thorough sanitation. Remove or destroy overwintering debris. Insects will be reduced also.
4. Rotate crops if land is available.
5. Practice good cultivation. Maintain weed-free crops.
6. Purchase pest-free plants.
7. Make interplantings if possible in order to reduce large areas of monoculture.
8. Avoid unnecessary use of insecticides that may eliminate beneficial parasites and predators.

Timing of Treatments

The application of most pesticides for vegetable insect control can be considered as a preventative practice. This theory, though, runs contrary to commonly accepted principles of modern pest management. The high value of the vegetable crop and the low economic threshold for damage (set by the consumer), however, allow preventative treatments to remain a valid concept. Treatments generally should be made before damage is detected (as for seed-

attacking insects, white grubs, wireworms, cutworms, etc) or at the first indication of insect presence or damage. Growers should consider alternating two insecticides when treatments are required on a scheduled basis. This practice may help prevent the development of insecticide resistance in insects and mites. When plants are actively growing, treatment intervals may have to be shortened in order to provide adequate protection for new plant growth.

Common Insecticides Labeled for Vegetable Pest Control

Many insecticides are labeled for control of various pests on vegetables in Iowa. Use only those insecticides which list on the label the **vegetable** to be treated and **pest** that you are attempting to control. Use of a pesticide inconsistent with its label is a violation and may result in illegal residues in your vegetables and subject you to civil or criminal penalties.

Listed below are some of the more common insecticides and insects listed on the label for control.

INSECTICIDE	Aphids	Bean Leaf Beetles	Leafhoppers	Mites	Flea Beetles	Cabbage Loopers	Cabbage Worms	Cutworms	Corn Earworms	Co. Potato Beetles	Seed Corn Maggots	White Grubs	Cucumber Beetles	Squash Bugs	Squash Vine Borers
Guthion	X	X	X	X	X	X	X		X	X			X		
Sevin			X		X		X	X	X	X			X	X	
Systox	X		X	X											
diazinon	X		X	X	X		X	X	X	X	X		X		
Kelthane				X											
Cygon	X		X	X							X				
Dyfonate											X				
Thiodan	X				X	X	X	X	X				X	X	X
Ethion		X	X	X											
Malathion	X		X	X	X	X	X	X					X		
Lannate	X		X		X	X	X	X	X						
Nudrin	X		X		X	X	X		X						
Phosdrin	X		X	X		X	X	X	X						
Monitor	X		X	X	X	X	X			X					
Dibrom	X		X	X	X		X	X	X				X		
MSR	X		X	X				X							
Thimet	X		X		X					X	X				
Rotenone	X				X	X	X			X			X		
Dylox							X							X	

Use of Airblast Sprayers

Airblast sprayers are frequently used in potato, tomato, and other vegetable crops for controlling certain insects. Good insect control can be obtained through the use of proper insecticides and because of mobile insect populations. These factors are important when using airblast sprayers:

1. Do not operate when wind is over 5 MPH.
2. Do not cover too much ground between driveways.
3. Use correct gallonage and pressure.
4. Adjust the vanes and nozzles to give best coverage.
5. Use cross drives in order to blow material **down** rows.

Re-entry Intervals

Workers must wear protective clothing if they enter treated fields before specified time periods for certain insecticides:

Insecticide	Hours
Guthion	24
Systox	48
Ethion	24
Parathion	48

Protective clothing must also be worn for all insecticides if the worker enters the treated field before the spray has dried or the dust has settled.

Beneficial Insects

Beneficial insects such as lady beetles, assassin bugs, stink bugs, flower bugs, braconid wasps, and ichneumonid wasps are commonly found in all commercial vegetable fields. The most common predator is the lady beetle, which feeds generally on aphids. Larvae are alligator-shaped and also feed on aphids and other vegetable pests. Many species of wasps are present which parasitize loopers and other lepidopteran larvae and eggs. Although natural populations of parasites seldom control pest insects, they help reduce the population. The overuse of insecticides will rapidly deplete beneficial insects.

Convergent lady beetle

Beneficial insect populations can be maintained by:

—avoiding excessive pesticide use

—using selective pesticides when possible

—leaving untreated areas for parasites and predators to survive.

The introduction of predator insects or parasites generally has not resulted in the establishment of these insects. This practice is not recommended for most Iowa vegetable growers.

MAJOR INSECTS ON FRUITS

SCALE INSECTS

Scale insects such as Forbes scale, San Jose scale, and Putman scale infest orchards all over Iowa. Young scales winter on the bark and become active when apples bloom. They weaken trees and blemish fruit. Dormant oil sprays controll all orchard scales found in Iowa. Summer sprays greatly reduce infestations of these pests.

San Jose scale

APPLE MAGGOT

The apple maggot is a serious pest in northern and central Iowa. Often maggots are not discovered in fruit until harvest time. Maggots are the larvae of flies. Hibernation takes place inside a small, brown puparium buried one to six inches deep in the soil.

Apple maggot or railroad worm

The flies emerge during the summer usually in June. The females lay eggs through punctures in the apple skin. In five to ten days the eggs hatch into legless

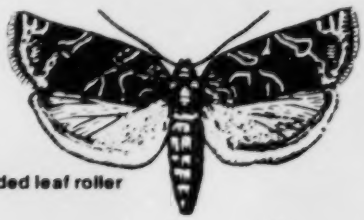
white maggots which tunnel through the fruit. They complete their development about a week after the apples fall to the ground. The larvae burrow into the soil to pupate.

Widespread heavy infestations may be expected if the weather is cool and rainfall is abundant. Since sprays for control are timed to coincide with the presence of adult flies, bait traps to attract the emerging flies will help to establish the time they first appear.

To Control: Spray trees and brush both around and in the orchard. Apply the third cover spray at about the beginning of apple maggot fly activity. The full schedule of recommended apple sprays is needed to control the apple maggot.

RED-BANDED LEAFROLLER

The first brood of these small greenish to greenish-brown caterpillars appears early in June and the second brood in late July, attacking leaves, buds and fruits. There are two full broods each year in Iowa, with a third brood sometimes appearing in early September. First brood larvae are usually found on the undersides of young water-sprout leaves. The larvae of all broods injure fruit where a leaf lies against the

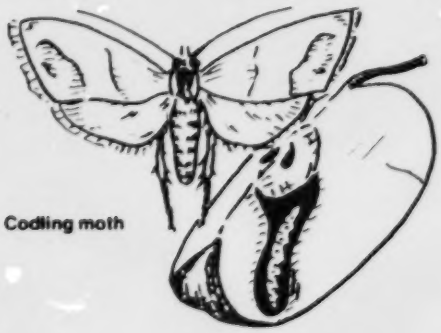


Red-banded leaf roller

surface of an apple or where two apples touch. Use pheromone traps to determine the need for and the timing of sprays. Make a special effort to spray thoroughly the underside of leaves and the inside of trees.

CODLING MOTH

This serious pest overwinters as a full-grown larva (pinkish-white, one-inch caterpillar) inside a silken cocoon under loose scales on apple bark or in other sheltered places. Adults emerge in May and June.



Codling moth

Eggs are laid on or near clusters of apples. Larvae enter the apple at the blossom end or through the side of the apple. There are two generations of codling moth in Iowa each year. Pheromone traps can be used to determine the need for and the timing of sprays for codling moth control.

APPLE INSECT TRAPS

Pheromone traps for codling moth and red-banded leafroller, and bait traps for apple maggot are available from Zoecon Corporation, 975 California Ave., Palo Alto, Calif. 94304.

PLUM CURCULIO AND OTHER CAT-FACING INSECTS

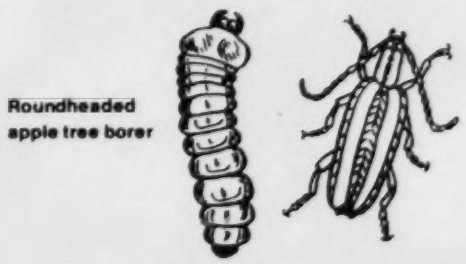
Several different species of insects sting young fruits, leaving a depression or "dimple." The mature fruit with several such dimples is said to be "cat-faced." The plum curculio feeds on leaves and petals. They injure young fruit by feeding and laying eggs in small circular excavations marked by a

Plum curculio

crescent-shaped slot underneath. These insects begin their activities early in the spring and damage continues into midsummer. Spray trees and brush bordering the orchard.

BORERS

The two most common insect borers in apple trees are the roundheaded apple tree borer and the flatheaded apple tree borer. The roundheaded apple tree borer usually burrows in the base of the trunk from 2 inches below the ground to a foot or more above the ground. The flatheaded apple tree borer burrows higher in the trunk and sometimes infests



Roundheaded apple tree borer

branches. In addition, bark beetles may also become a problem in apple orchards. Fortunately, apple tree borers and bark beetles are seldom a problem in well-managed orchards due to the insecticides ap-

plied in the cover sprays and the usually vigorous condition of the trees which inhibits infestation.

ORCHARD MITES

Damaging clover mites, European red mites, and two-spotted mites may be numerous in Iowa orchards. Clover mites and European red mites overwinter in the egg stage around leaf scars, buds, and nodes. Two-spotted mites overwinter as mature females under bark or under ground cover around the bases of trees. Predator mites overwinter in the same locations as the two-spotted mites. In any given year, one species of mite may be much more destructive than the other two. Damaging mites in some Iowa orchards have developed resistance to some of the recommended miticides. Resistance can be caused by continued use of either a phosphate or non-phosphate miticide for two or more seasons. Fortunately, predator mites can develop miticide resistance along with the damaging mites.

European red mite

Management of Mite Populations

Traditionally, orchard mite control in Iowa has consisted of using miticides to try to kill every mite in the orchard. Research has shown that this practice may be unnecessary, uneconomical, and even harmful. Attempts to kill all mites in an orchard will kill predator mites as well as damaging mites. If an orchardist kills all damaging mites and no predator mites, the predator mites will starve. The best mite situation is one in which both damaging and predator mites are present but with enough predator mites to hold the damaging mite population below economic levels. Research has shown that this mite management can be achieved if certain criteria are met and certain procedures are followed:

1. Mite management means constant surveillance. It is necessary to survey the orchard for mites every week throughout the season.
2. Recognition of predator mites is essential. Predator mites are similar in size to two-spotted mites but are whitish during winter and straw colored during the summer. They generally move faster than damaging mites; they migrate to the tree crowns from their overwintering sites during mid-June.
3. Some vegetation around the base of the trees is important to provide overwintering sites for the predator mites. Normal mowing misses are enough for this purpose.
4. A superior dormant oil spray should be used if European red mites were a problem last year. This spray will not harm predator mites because they migrate up into the tree after bloom. A good oil spray will provide mite control until the second to fourth cover spray or until predatory mites have migrated into the tree.
5. Approximately 10 plant damaging mites per leaf in June and 15 per leaf in July and August are enough to be considered a damaging population. However, if you have 1 predator mite for every 10 plant feeding mites, the population should be held below the level of economic damage.
6. If predator mites are present but are not regulating the plant feeding mites, use a single application of Plictran 50% WP (6 oz. per acre) OR Omite 30% WP (2 lb. per acre). These reduced rates will help control the damaging mites for the rest of the season without doing undue harm to the predator mites.

Controlling Fruit Insects

The following chart lists insecticides and acaracides labeled for some of the more common fruit pests. This list is only a guide. The label should be carefully read before using any pesticide in the orchard.

	Scale	Apple-maggots	Red-Banded Leafrollers	Codling Moth	Plum Curculio	Borers	Mites
Carbaryl	X	X	X	X	X		X
Chlorobenizlate							X
Chloroprophylate							X
Diazinon	X	X		X			X
Guthion	X	X		X	X		X
Gardona		X	X	X	X		
Imidan		X	X	X	X		X
Kelthane							X
Malathion	X		X	X	X		
Methoxychlor	X	X	X	X	X		X
Morestan							X
Omite							X
Ovex							X
Plictran							X
Superior Dormant Oil	X						
Tedion							X
Thiodan						X	X

Spray Compatibility

The chart below lists known compatibilities of commonly-used insecticides and fungicides. Use caution when mixing fungicides in wettable powder formulations with liquid concentrates. The wettable powder should be in suspension **before** adding the liquid pesticide. If in doubt about compatibility, test a batch in a bucket before proceeding with a tank mix.

Check alkalinity of the water supply you use before spraying. Alkaline water (pH 8.0 or above) rapidly decomposes organo-phosphate insecticides. Alkalinity can be reduced by adding vinegar or citric acid.

Key to symbols:

X = may be combined

O = do not combine

— = caution in combining; questionable compatibility or mixture may cause injury or materials may break down in mixture.

Acaralate	Benlate	Bordeaux	Captan, Folpet	Carbaryl	Chlorobenzilate	Copper (fixed), copper resin	Diazinon	Difolatan	Dikar	Dodine	Ferbam, Maneb plus Zinc, Zineb, Polyram	Fundal-Galecron	Glyodin	Guthion	Imidan	Karathane	Kelthane	Lime	Oil, superior	Morestan	Omite	Ovex	Plictran	Sulfur, wettable	Tedion	Thiodan
			X	X			X			O	X			X			X							O		
			X	—	O	X																				
					X																					
		X		X			X	X	X	X	X	X	O	X	X	X	X	O	X	X	X	X	X	O	X	X
X			X	X		X																				
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X	X		X	X	X		X	X	X	X																
		O	X	X		O		X		X	X															
		X	X	X			X	O	X	X	X	O														
X	X		X	X	X	X	X		X		X	X	X													
	X		X	X		X		X	X	X	X	X														
			X	X				X	X	X	X	X	X		X											
X		X		X	X	O	X				X			X	X											
		X	O	O	O			O		O		O	X	O			O									
		O	X	X	X	X	X	O	O	X	X	X	X	X		X	X									
X		X	O		O		X	X				X	X			O	X	X	X							
X			X	X	X	X	X	X	X	X			X			X		X	X							
X		X	X	X		X	X	X			X		X	X				X	X							
	X			X			X										X									
O		X	X	X	X		X	X	X	X	X	X	X		X	X	X	X	O	X	X	X	O			
X		X	X	X		X	X	X			X		X	X	X			X	X	X			O	X		
	X	O		X		X	X				X	X			X			X	X		X	X		X	X	

Spray Schedule for Insects and Mites on Apples

These schedules cover the more troublesome insects and diseases of Iowa apples. You probably won't have to fight all of these pests. This information is designed to help you work out your own spray schedule to fit your orchard conditions.

DORMANT SPRAY — Apply a dormant spray in March or early April—through the silver tip stage—to control overwintering scales and mites. Dormant sprays will injure opening foliage.

For Forbes scale, San Jose scale, Putnam scale and mite eggs: 3 gal. dormant spray oil.

For oystershell scale: 5 gal. dormant spray oil.

PINK SPRAY — Also called "cluster-bud."

Spray for control of curculio and "cat-facing" insects such as lygus and plant bug complex; also bud moth, fruit worms, and cankerworms.

IN-BLOOM SPRAY — Don't use any insecticide at this time to protect bees needed for pollination.

PETAL-FALL — Sprays through the petal-fall stage should be timed to coincide with the stage of development of leaf and fruit buds. Sprays after petal-fall should be timed according to the interval listed for each cover spray. The protective spray film is broken after each application because leaves and fruit continue to grow. Apply an insecticide when 90 percent of petals have dropped.

FRUIT THINNING	Fruit thinning sprays may be needed on some varieties.
FIRST COVER SPRAY	Four or more cover sprays will be needed to control the first brood of codling moth. Pay special attention to getting good coverage in tree tops. For plum curculio, blotch starts to develop about 2 weeks after blossoming.
SECOND COVER SPRAY	Examine water sprouts for presence of red-banded leafroller. Apply a spray treatment.
THIRD COVER SPRAY	This is a good time to check mite population. Watch for orchard mites and red-banded leafroller.
FOURTH COVER SPRAY	Apply for control of mite and red-banded leafroller and for apple maggot in central and northern Iowa.
FIFTH COVER SPRAY	Apply 7 to 8 days after the fourth cover spray: same materials as for fourth cover spray for control of apple maggot and for control of mites. Don't relax the spray schedule at this point. Second brood codling moth, red-banded leafroller, apple maggot, and mites (especially the two-spotted spider mite) can severely damage your crop between now and harvest.
ADDITIONAL COVER SPRAYS	Apply a spray every 7 or 8 days. Use same materials as for fourth cover spray.
LAST COVER SPRAY	For time interval between insecticide application and harvest, see chart. Apply spray for control of red-banded leafroller, apple maggot, and mites. Apply last cover spray in early September on later maturing varieties to control red-banded leafroller, apple maggot, and mites.

Safety Considerations

The organic phosphates (such as Guthion, diazinon, and Imidan) are highly effective insecticides and miticides which can be very toxic to man. Accidental contact with the concentrates or prolonged or repeated exposure to dilute spray drift has resulted in several deaths in the United States. In spite of this, alert orchardists willing to take necessary precautions have used these materials successfully during recent seasons.

The following suggestions are offered for the safety of those who mix and apply sprays containing the organic phosphate compounds listed above:

1. Use the wettable powder concentrate formulations treated to prevent "dusting." The liquid concentrate forms are extremely hazardous.
2. Wear natural rubber gloves, goggles, and washable cap while mixing products in the spray tank.
3. Wear rubber gloves and rubber boots during entire spraying operation if hand gun is used. Wear goggles, washable cap, coverall suit with the collar turned up and sleeves rolled down throughout the spraying operation.
4. Always spray with the wind.
5. Do not permit concentrates to contact any exposed part of the body. Have available at all times a supply of clean water to wash off any spray materials spilled on hands or any exposed body parts.
6. When through spraying for the day, remove all clothing and shoes and wash yourself thoroughly with warm water and soap. Put on clean garments each day.
7. Notify your doctor that you are using organic phosphate compunds so he can be prepared to treat you in case of poisoning symptoms.
8. Do not allow livestock to graze in sprayed orchards. Do not cut orchard cover for hay. Do not allow spray drift into adjacent pastures or hayfields.

Fruit growers face a hazard from successive uses of several different insecticides or multiple exposure to a single chemical. All organic phosphorus insecticides may reduce the activity of an essential enzyme—cholinesterase. Exposure to parathion or Guthion causes a sharp reduction; malathion, Korlan, and diazinon cause a less severe reaction. Carbaryl, a carbamate insecticide, may also reduce cholinesterase activity.

A fruit grower may suffer cholinesterase depression from improper use of parathion or Guthion without observing any symptoms. If he then uses malathion, Korlan, or diazinon, also improperly, to control flies in barns again without symptoms but with further cholinesterase depression, he may collapse when he uses "safe" carbaryl on his grapes or apple trees.

Because of the cumulative or additive effects of these chemicals, every user should protect himself (protective clothing and a respirator) against all exposure to the cholinesterase-depressant insecticides. Know the symptoms of cholinesterase depression, and notify your doctor at the beginning of the season that you will be using the above named chemicals.

Unopette Cholinesterase Kits are available from the Becton-Dickinson Co., Rutherford, New Jersey 07070. The kits are also available from some local medical supply houses. Kits cost about $24.00 for 20 tests.

Common Fungicides Registered for Fruit and Vegetable Crops

COMMON NAME	TRADE NAME	Apple	Grapes	Stonefruits	Raspberries	Strawberries	Asparagus	Beans	Cabbage	Carrots	Corn	Cucurbits	Onions	Potatoes	Tomatoes
Anilazine	Dyrene														X
Benomyl	Benlate	X	X	X	X	X		X				X			
Captan	Orthocide Captan	X	X	X	X	X		X	X	X	X	X	X	X	X
Captafol	Difolatan	X		X								X	X	X	X
Chlorothalonil	Bravo							X	X	X	X	X	X	X	X
Copper-fixed	Copper N Citcop 4-E Kocide		X	X				X	X	X		X	X	X	X
Dinocap	Karathane	X			X	X						X			
Dodine	Cyprex	X												X	
Tin-phenyl-Tin	Duter				X	X								X	X
Mancozeb	Dithane M-45 Manzate 200	X	X	X			X			X	X	X	X	X	X
Maneb	Dithane M-22 Manzate-D	X	X	X			X			X	X	X	X	X	X
Metiram-zinc	Polyram	X					X			X		X	X	X	X
Streptomycin	Agrimycin Agristrep	X												X	
Sulfur	Sulfur	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Thiram	Thiram (seed treatment)							X	X	X	X	X	X	X	X
Zineb	Zineb, Parzate Dithane Z-78	X	X		X	X	X	X		X	X	X	X	X	X

Harvest Intervals

The minimum safe harvest intervals for commonly used insecticides and acaracides are listed below. This list is only a guide and the label should be checked before the pesticide is used.

MINIMUM DAYS FROM LAST APPLICATION UNTIL HARVEST (FOR APPLES)

Pesticide	Days
Carbaryl	1
Chlorobenzilate	14
Chloropropylate	14
Diazinon	14
Guthion	7
Gardona	7
Imidan	7
Kelthane	7
Methoxtchlor	7
Morestan	35
Omite	7
Ovex	30
Plictran	14
Tedion	0
Thiodan	30

SPECIAL THINGS TO CONSIDER WHEN APPLYING FRUIT AND VEGETABLE PESTICIDES

Preharvest and Re-entry Intervals

Many pesticides are restricted by a minimum time from last application to harvest. This time requirement is known as the **preharvest interval.** The label and extension pest control publications furnish needed information on this restriction. Preharvest intervals should be carefully observed to prevent harvesting an illegally contaminated product.

The minimum time between applying a chemical and workers entering the treated area is known as the **re-entry interval.** This restriction is presently required only for some pesticides that are highly toxic to warm-blooded animals. Re-entry intervals should be carefully observed.

Phytotoxicity

When a chemical burns a plant to which it is applied, it is said to be phytotoxic (plant toxic). If the plant is a weed and the chemical a herbicide, the result is good, but usually the word "phytotoxic" is used when a pesticide adversely affects plants. Phytotoxicity may occur due to drift to nontarget plants, excessive rates, mixing of chemicals that are not toxic when used alone, and using chemicals in a more concentrated form than desirable. Certain weather patterns may cause or increase the amount of phytotoxicity. Exceptionally bright, hot, dry weather following a period of cooler weather is such a situation. It is not unusual to get some phytotoxicity when using pesticides in accordance with recommended practices. It is unusual to have a severe phytotoxicity problem under these circumstances.

To avoid phytotoxicity, apply chemicals within recommended rates. Do not mix chemicals unless the label indicates it is all right. Time applications according to recommendations. Use recommended water rates.

Residues

The amount of a pesticide that remains after application is the residue. The ideal pesticide would be residual enough to control a pest for the length of time needed and then break down into completely harmless chemicals. Unfortunately, this is not the case with most pesticides. The long residual nature of chlorinated hydrocarbons is one of the main reasons they are being used less. Usually a tolerance

is set for each chemical that is registered on a crop. It is expressed in parts per million (ppm). The residue that remains on the harvested crop cannot exceed the tolerance that was set when the pesticide was labeled. This has a direct relationship on the preharvest interval. Registered and recommended rates should not be exceeded because the residue may exceed the legal tolerance.

The residue of pesticides in soils may create problems. If a chemical is legally used on one crop and it is not legal on the succeeding crop, an illegal residue may result. See the section on contamination of soil and water for additional information.

Environmental Contamination

Nontarget Injury and Community Problems: Care should be exercised not to contaminate nontarget areas when applying a pesticide. This is particularly true of food and feed crops, bodies of water, apiaries, woodlands, and urban areas. Information on the least hazardous recommended chemical to use where there is danger of contamination can be obtained from county extension offices.

Drift is probably the chief culprit contributing to contamination of nontarget areas. Pesticides should be applied when there is little or no wind. Under no conditions should pesticides be applied if wind exceeds 10 miles per hour. Using extremely low volume and air delivery spraying systems increases the problems of drift. Some pesticides may badly damage or completely destroy some crops if they are allowed to drift onto them.

Such precautions as spraying when there is little or no wind, using the least volatile forms of dangerous chemicals, and avoiding breaking spray into very fine particles will help prevent these problems.

Contamination of Soil and Water: When pesticides are being used, care should be taken to prevent undue contamination of the soil and bodies of water. Select the pesticide that is least likely to cause contamination problems.

For example, carefully mark each swath in order to avoid a double application. Some herbicides and long residual insecticides may have a carryover effect if excessive rates are used. This could contaminate or destroy subsequent crops.

When bodies of water are in close proximity to the area being treated, select the recommended chemical that would be least likely to contaminate the water. Apply the chemical when there is no wind or when the wind drifts the chemical away from the water. Do not apply the chemical when heavy washing rain is probable.

Controlling Herbicide Drift

The term "drift" refers to the movement of herbicides through the air to areas not intended for treatment from areas of intended treatment. It presents a potential hazard to sensitive vegetation (crops, gardens, ornamentals), wildlife, people, livestock, and aquatic areas adjacent to rights-of-way.

Types of Drift:

(1) Particle drift—At the time of application, small spray droplets can be carried by air movement from the application area to other areas.

To reduce the danger of particle drift damage:

—use nozzles that apply a coarse spray;

—use low pressures;

—avoid spraying on windy days when drift could occur;

—spray when air movement is away from susceptible crops or ornamentals;

—if drift is a hazard and spraying is necessary, use special drift control agents or formulations in properly designed and adjusted equipment.

Particles of fog or mist size present the greatest drift hazard. These size particles are often generated by high volume spraying equipment using high pressures for foliage treatment of trees and brush.

(2) Vaporization—This results from the tendency of chemicals to vaporize or give off fumes. The movement of such fumes with wind currents may injure sensitive vegetation a mile or more from the point of application.

Ester formulations of the phenoxy-type herbicides (2,4-D; 2,4,5-T; 2,4,5-TP; etc.) present the greatest potential for vaporization. Amine formulations of these herbicides are essentially nonvolatile and do not present a vapor drift hazard.

Drift Control Agents[1]: Adjuvants and application systems have been developed which help overcome certain inherent drift problems that exist in conventional spraying.

Three of these systems are:

(1) foams,

(2) invert emulsions, and

(3) spray additive stabilizers.

Though different in method, all three systems offer better drift control and more highly visible spray (better placement).

[1]This section adapted from E. I. DuPont DeNemours & Co., Inc. Manual A-86439 "Weed and Brush Control-Technical Manual for Professionals," pp. 6-7.

AND JUSTICE FOR ALL

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CATEGORY 1D

FRUIT AND VEGETABLE DISEASE CONTROL
(SUPPLEMENT)

FRUIT AND VEGETABLE DISEASE CONTROL

Broadly speaking, a plant is said to be diseased when it is continuously affected by some factor which interferes with its "normal" structure or activities; disease usually produces some outward signs and/or symptoms. The inclusion of the word "continuously" excludes such things as insect injury.

Disease is a term usually reserved for those problems caused by parasites: fungi, bacteria, nematodes, viruses, mycoplasmas and parasitic seed plants. Some disorders caused by things other than parasites are often confused with diseases. These problems are caused by such things as unbalanced fertility, toxic chemicals, air pollution, etc. They often resemble diseases caused by certain parasites. For example, certain types of spray burn look much like some leafspot diseases. In many instances, it is difficult to determine the cause without several days of laboratory work.

Symptoms and signs of a disease are the basic keys to plant disease identification. A "symptom" of a disease is the reaction of the host plant to invasion by the parasite or injury from the nonparasitic factors: spots on the leaves or wilting. A "sign" is physical evidence of the pathogen: visible growth of fungus spores, for example.

All disease symptoms and signs are caused by an interaction between the host plant, the pathogen (parasitic causal agent) and the environment. Some specific pathogens are able to attack a number of different plant species, and the symptoms of the disease may be entirely different on each different plant. Diseases caused by nematodes may have no visible aboveground symptoms if soil moisture is adequate.

CONTROL OF TREE FRUIT DISEASES

CROP	DISEASE	CAUSAL AGENT	DAMAGE SYMPTOMS	CONTROL
Apples	Apple scab	Fungus (fallen leaves)	Olive-colored, smokey spots on leaves and petioles, fruit scabby and misshapen.	Spray foliage and fruit: Benomyl 50 WP, Captafol 39F (single application at 1/4 inch green), Captan 50 WP, Dodine 65WP, Folpet 50 WP, Glyodin, Maneb + Zinc, Polyram 80WP, Thiram 65WP or Zinc ion + Maneb.
	Cedar-apple rust	Fungus (Junipers)	Yellow to orange spots on upper surface of leaves. Small, light orange to tan, tubular structures on underside of leaf develop in July and August.	Remove Junipers within 1/2 mile of the orchard. Spray Ferbam 76 WP, Maneb + Zinc, Polyram 80WP, Thiram 65WP, Zinc ion + Maneb, or Zineb 75WP.
	Fire blight	Bacterium (cankers and mumified fruit)	Blossoms, leaves, young shoots, and fruit rapidly darken and die, young shoots wilt and form "sheperds crooks." Shallow, sunken, dead areas in bark of young twigs and branches.	Avoid nitrogen fertilizer. Spray with Streptomycin or fixed coppers.
	Black rot Frog eye leafspot	Fungus (dead fruit and wood)	Brown zonate spots on fruit. Leaf spots at first purple then tan to gray with a purple margin. Cankers on twigs and limbs.	Sanitation--remove and destroy mumified fruit, dead twigs and branches. Spray with Captan 50WP or Zineb 75WP in regular schedule.
	Bot rot	Fungus (dead wood)	Blisters filled with liquid on limbs and twigs. Wet areas on bark become sunken, dark-colored lesions. Egg-shaped, rotted spots on fruit.	Sanitation--remove and destroy dead wood. Spray with Captan 50 WP, Folpet 50 WP or Zineb 65 WP in regular schedule.
	Powdery mildew	Fungus (air-borne spores or overwinter in terminal buds)	Grayish-white, powdery mold on leaves, buds, blossoms and twigs. Shoots stunted, leaves distorted, fruit russeted.	Spray with Benomyl, Dinocap (Karathane) or Dikar.
	Blotch	Fungus	Diffuse, slightly sunken, dark-colored blotches on surface of fruit, may also cause cankers on spurs, twigs and branches.	Benlate, Ferbam, Maneb + Zinc or Zineb in early cover sprays or 8-8-100 Bordeaux as a dormant spray.

CONTROL OF TREE FRUIT DISEASES (Cont.)

Apples (Cont.)	Sooty blotch	Fungus	Irregular, "sooty" brown to black spots up to 1/2 inch in diameter on surface of fruit.	Avoid Captan if this disease develops. Alternate Captan with Benlate, Maneb with Zinc or Zineb in summer fungicidal sprays.
Stone Fruits cherries peaches plums	Leaf spot Shot-hole	Fungus (leaves)	Small, round, dark spots on leaves--spots may drop out, causing shot-hole effect. Leaves turn yellow and fall. Repeated defoliation seriously weakens the tree. Subject to winterkill.	Sanitation--spray with Benomyl, Captan, Dedine or fixed coppers (do not use copper sprays on cherries).
	Brown rot	Fungus (on fruit)	Blossoms and young twigs may be blighted. Fruit turns brown, shrivels; small, tan-colored tufts of mold growth may be present on affected tissues during damp weather.	Sanitation--destroy mumified fruit. Spray with Benomyl, Difolatan, Folpet or wettable sulfur.
	Leaf curl (peach, apricot plum [plum pockets])	Fungus	Leaves curled, twisted and leathery. Reddish to purplish in color, later withering and falling. Fruit reddish and warty--falls early. On plum, fruit is large, light-colored and hollow.	Sanitation--destroy infected leaves and fruit. Spray--dormant application of Bordeaux 4-4-50, Difolatan or Ferbam.
	Black knot (Plum)	Fungus (on cankers)	Elongated, black swellings on twigs and small branches--die back.	Sanitation--destroy nearby wild plums, prune out and destroy affected twigs and branches. Spray--dormant application of Bordeaux 8-8-100.
	Powdery mildew (cherry)	Fungus (on leaves)	Powdery, whitish to gray mold patches turning rusty brown to black. Leaves and shoots stunted and distorted, fruit dwarfed.	Spray with Benomyl, Karathane or wettable sulfur.

CONTROL OF SMALL FRUIT DISEASES

CROP	DISEASE	CAUSAL AGENT	SYMPTOMS	CONTROL
Grapes	Black rot	Fungus (leaves and fruit)	Small, reddish-brown spots on leaves, pale birds-eye spots on green, immature fruit, turning brownish-black, wrinkled, and eventually mummifying. Infected fruit "shells" easily. Blossoms blasted.	Sanitation--destroy infected fruit. Spray with Benomyl, Captan, Ferbam, fixed copper or Folpet.
	Downy mildew	Fungus	Light, greenish-yellow patches on leaves later turning reddish-brown. White, downy growth on underside of fruit. Shoots and tendrils also affected. May cause killing of all these tissues.	Sanitation--spray with Captan, fixed coppers or Folpet.
	Dead arm	Fungus	Young shoots, trunk and branches killed by perennial, elongated, reddish-brown cankers which girdle affected portions of the plant.	Destroy affected plant parts. Spray as for black rot--Captan and Folpet are particularly effective.
	Powdery mildew	Fungus	Powdery, white mold patches on leaves, shoots, tendrils and young fruit. Leaves stunted, yellowed and may wither. Berries dwarfed, misshapen, russeted and cracked.	Spray with Benomyl, fixed coppers, Folpet or sulfur.
	Fruit rots	Fungi (various)	Ripe fruits rot--may be covered by mold growth during damp weather.	Spray as for black rot with Benomyl, Captan or Thiram.
Raspberries	Anthracnose Black varieties most susceptible	Fungus (leaves and canes)	Purplish spots on young canes and spurs. Enlarging and developing tan centers with purple margins. Fruit from infested canes dry, small and seedy.	Sanitation--remove and destroy old fruiting canes immediately after harvest--also heavily infected canes. Spray with lime sulfur at ½ inch green and Ferbam or Captan in later spray.
	Spur blight	Fungus	Chocolate brown, purplish or bluish lesions 1-2 inches long on leaf petioles and new canes. Canes girdled with infected areas becoming gray.	Same as for anthracnose.

CONTROL OF SMALL FRUIT DISEASES (Cont.)

Strawberries	Common leaf spot	Fungus (leaves and seed)	On leaves--small, purplish-red spots later developing light gray centers. Black seed on fruit.	Avoid dense, matted beds. Spray with Benomyl, Captan or Thiram.
	Leaf scorch	Fungus (leaves, petioles, stolons and fruit stalks)	On leaves--small, dark purplish spots enlarging and turning dark brown. Leaves dry, appear scorched. Petioles, stolons and fruit stalks develop sunken reddish-purple streaks or spots, fruit caps turn brown.	Same as for leaf spot.
	Leaf blight	Fungus	V-shaped blotches of yellow with red to purple margins on leaves.	Same as for leaf spot.
	Fruit rot	Fungi	Fruit rots as it ripens--especially during rainy weather.	Avoid high nitrogen fertilization and dense, matted beds. Spray with Benomyl or Captan.

CONTROL OF VEGETABLE DISEASES

CROP	DISEASE	CAUSAL AGENT	SYMPTOMS	CONTROL
Asparagus	Rust	Fungus	Elongated, yellow or orange, becoming black, powdery pustules on stems and foliage. Tops turn yellow and die prematurely.	Plant rust-resistant varieties. Destroy volunteer plants in and near field. Destroy tops in fall. Spray with Maneb, 1-1½ lbs., Zinc ion plus Maneb, 1-1½ lbs., Polyram or Zineb, 1-1½ lbs. Apply at 7- to 10-day intervals to fern growth only. REF: USDA Farmers Bulletin #2232
Beans	Seed rot	Various fungi	Germination failure, poor stand, seed rotted, seedlings rotted at or below soil line.	Seed treatment with fungicide: Captan 75 WP-2.05 oz/100 lb. seed --overdose may injure seed. Chloranil-4 oz./100 lb. seed. Dexon-0.7 oz./100 lb. Combine with Captan or Thiram--overdose may cause injury. Thiram 75 WP-1½ oz./100 lb. seed.
	Common and halo blight	Bacteria on crop residue	Foliar lesions--irregular brown blotches with yellow margins. Yellow halo more pronounced in halo blight. Infected tissue falls out--ragged leaves. STEMS & PODS--water soaked areas becoming brownish-red and sunken. Stems may be girdled. Diseased seed may appear healthy, show yellowish, varnish-like areas or be shriveled and killed.	Use Western-grown seed. Three- to five-year crop rotation. Plow under crop residue. Spray when first symptoms appear. Kocide--2 lbs./100 gal. Streptomycin-400 ppm--apply only on seed crop or before pods appear on table beans. Do not feed to livestock.
	Anthracnose	Fungus on crop residue	Sunken, reddish-brown lesions on pods, elongated on stems. Veins on underside of leaves may be reddish-brown, darkening with age. Infected seed shriveled.	Certified disease-free seed. Plow under crop residue. Sprays, start before symptoms appear. Continue at 4-day intervals: Ferbam-3 lbs./100, to 4 days of harvest. Kocide 101-3/4 lb./100. Zineb-1½ lbs./100. Tri-basic copper sulfate-1½-2 lbs./100.

CONTROL OF VEGETABLE DISEASES (Cont.)

Beans (Cont.)	Rust	Fungus on crop residue	Dark brown, pinhead-sized pustules on leaves. Leaves turn yellow, wither and fall.	Plow under crop residue. Spray: Maneb 1-1½ lbs./100 until 4 days of harvest on snap beans. Zineb 1½-2 lbs./100.
	Mosaic	Virus--aphid transmitted	Plants stunted, leaves dwarfed, curled, mottled with green, dark green and yellow.	Plant certified disease-free seed. Avoid planting near other legumes (clover, alfalfa, etc.). Control aphids--see Entomology.
	White mold	Fungus (soil-borne)	Soft, slimy rot later covered with cottony growth of "mold" on pods, leaf axils and stems. Stem infection followed by wilting and death of plants. Most serious late in season when foliage is dense.	Three- to four-year rotation free of beans, crucifers, lettuce, potato and tomato. Where disease has been a problem, spray with Benomyl--1 lb. 50WP/acre--14-day limit before harvest.
Cabbage Broccoli Cauliflower Brussels sprouts	Black rot	Bacterium on crop residue and equipment	V-shaped, yellow areas at leaf margins. Veins discolored, black starting at base of V-shaped areas. Plants may be dwarfed or one-sided. Head rots quickly.	Hot water seed treatment at 122° F.: cabbage, 25 min., broccoli and cauliflower, 20 min. Use seed produced in Pacific NW. Avoid seedlings from southern states unless certified. Three year crop rotation. Plow under crop residue. Sanitize equipment (steam, 10% clorox-formaldehyde).
	Seed rot, damping off wire stem	Various fungi	Seed rots, seedlings wilt and collapse from rot at soil line. Stems may turn dark and woody. Seedlings make little, if any, growth.	Use certified seed or transplants. Treat seed with fungicides followed by hot water treatment. Captan, Thiram or Chloranil--½ lb. 75% WP/lb. of seed. Disinfect soil--Vapam, Chloropicrin, heat.
	Club root	Plasmodium (soil-borne)	Plants stunted, yellow, wilt during dry weather. May fail to produce marketable head. Roots clubbed and warty in appearance.	Plant in noninfected soil. Apply PCNB in transplant water--2-6 lbs. PCNB 75% WP/100 gal., 1/2-3/4 pt. per plant (use higher rates for heavy infestations--may be applied with insecticides, etc. in transplant water).

CONTROL OF VEGETABLE DISEASES (Cont.)

Cabbage (Cont.)	Downy mildew	Fungus on crop residue	Yellowing followed by browning and death of outer leaves with white or grayish mold development on undersides. Soft rot often follows. Young plants may blacken and die. Principally during wet weather.	Spray at first sign of disease. Bravo W75-1½ lb./100. Maneb-2 lbs./100, Fixed Coppers-2 lbs./100. Repeat applications at 7-day intervals. Plow under crop residue.
	Mosaic	Virus--aphid transmitted	Leaves yellower than normal. Mottled, crinkled and distorted. Plants may be stunted, premature leaf drop, dark spots on leaves.	Control weeds of mustard family. Control aphids--see Entomology.
Carrots	Seed rots, damping off	Various fungi	Poor stand, seed rots, seedling turns yellow, wilt and fall over.	Seed treatment: Captan 50% WP--2 tsp./lb. seed. Thiram 50% WP--2 tsp./lb. seed.
	Leaf blight	Several fungi Bacteria	Tan, gray-brown or black spots on leaves and petioles. Leaves eventually die.	Spray in field at first sign of infection at 7-10-day intervals. Fixed Coppers--2 lb./100 gal. Bravo W-75-1-1½ lb./100 gal.
	Yellows	Aster yellows Mycoplasma (formerly virus) leaf hopper transmitted	Stunted, yellowed and distorted leaves at the crown. Older leaves bronzed or reddish. Carrot dwarfed with dense hair-like rootlets.	Control weeds. Destroy infected plants. Control leaf hoppers--see Entomology.
	Root knot	Nematode (soil-borne)	Carrots forked, misshapen, smaller roots. Knotted or beaded in appearance.	Two to three year rotation with a grass crop. Fumigate soil at least 14-21 days before planting, preferably in fall. Previous season use DD, EDB, Telone, Vedden D or Vorlex. All fumigants are hazardous, follow manufacturer's directions.
Corn, sweet	Seed rot Seedling rot	Various fungi (soil-borne)	Poor stand, seed rotted, seedlings killed at or below soil level.	Seed treatment: Captan, Chloramil, dichlone or Thiram, 2-4 oz. 75% WP/100 lbs. seed. Do not use treated seed for food or feed.

ONTROL OF VEGETABLE DISEASES (Cont.)

orn, sweet Cont.)	Southern blight	Fungus on crop residue	Tan spots ¼ to ½ inch long with yellow halo on leaves and husks (spots may become much larger on husks, resembling aphid damage).	Use hybrids with N Cytoplasm. Spray at 7-10-day intervals: Bravo 75WP, 1½02 lbs., 14-day limit on corn for fresh market. Maneb, 1½ lb./gal. Zinc ion-Maneb.
ucurbits-- cucumbers melons pumpkins squash	Seed rot damping off	Various fungi (soil-borne)	Poor stand, rotted seeds, seedlings turn yellow, wilt and fall over--usually die.	Seed treatment: Captan, 3oz./100 lbs. seed. Chloranil, 3.8 oz./100 lbs. seed. Thiram, 3 oz./100 lbs. seed. Do not use treated seed for food or feed.
	Angular leaf spot	Bacterium on crop residue	Small, water-soaked spots on leaves, turn tan, drop out. Leaves ragged. Whitish crust may form on underside of leaves and on fruit.	Crop rotation--2 years. Fixed copper sprays at 10 to 14-day intervals, 2lbs./100 gal.
	Anthracnose Scab Leaf spot	Fungi on crop residue	Reddish-brown spots on leaves, petioles and stems. Leaves appear scorched. Sunken, scabby spots on fruits. Small fruits may turn dark and die.	Three year crop rotation. Plant certified disease-free seed of resistant varieties. Spray at 7-day intervals during humid weather after runners start to form. Bravo W-75 or 6F, Captan 50W, Fixed coppers, Folpet, Kocide Maneb, Maneb and Zinc ion. Zineb on cucumbers and melons only. Follow manufacturer's directions.
	Alternaria leaf spot	Fungus on crop residue	On cucumbers and cantaloup light brown spots with targeted appearance and surrounded by a bright yellow halo.	Plow under crop residue. Spray at 7 to 10-day intervals with: Bravo 6F, 1.5 pts./100. Difolaton, 1½ pts./100. Dithane M-45, 1.5 lbs./100 to 5 days of harvest. Maneb, 2 lbs./100 to 5 days of harvest.
	Cucumber mosaic	Virus	Leaves distorted, mottled with various shades of green and yellow. Fruit may be distorted and mottled.	Plant resistant varieties. Control weeds. Control aphids--see Entomology.

CONTROL OF VEGETABLE DISEASES (Cont.)

Cucurbits (Cont.)	Bacterial wilt	Bacterium	Plants wilt, turn yellow and die. Juice from freshly cut stems may be sticky, viscous.	Control cucumber beetles--see Entomology.
	Powdery mildew	Fungus on crop residue	Powdery or grayish-white mold, usually in patches on leaves. Leaves may scorch.	Spray at first sign of disease. Benomyl, ¼ lb./100, 2 applications at 10-day intervals. Karathane, ½ lb. WP, 7-day intervals to within 7 days of harvest.
	Fusarium wilt	Fungus (soil-borne)	Plants wilt and die. Fruit may rot, especially cantaloup. Brown streaks in stems and tap root.	Resistant varieties. Three to four year rotation.
Onions	Seed rot damping off	Various fungi (soil-borne)	Poor stand. Seedlings collapse, rot at or below soil line.	Seed treatment: Captan, Chloranil, Thiram. Follow manufacturer's directions. Do not use treated seed for food or feed.
	Onion smut	Fungus (soil-borne)	Elongated black powdery blisters in bulb scales and seedling leaves. Tissues swollen, distorted.	Treat seed with Thiram 75 WP, ½ lb./100 lbs. seed--planter box. Seed furrow application (75-125 gal./acre) at planting--high rate for dry soil. Formaldehyde 37%, 1.4 gal. per acre. Or Nubam 2 EC, 1 gal. Or Dithane M-45, 3 lbs. Or Manzate 200, 3 lbs.
	Blast	Fungus on crop residue	Small, pale spots, eventually browning. Collapse of tissue and entire leaves.	Sanitation: plow under crop residue. Destroy cull piles. Four year rotation. Spray at 7-day intervals. Maneb, 3 lbs./acre, Zinc ion and Maneb, 3 lbs/acre.
	Downy mildew	Fungus on crop residue	Sunken, pale green to grayish areas. Later covered with a purplish mold growth. Plants stunted, distorted.	Sanitation: plow under crop residue. Destroy cull piles. Four year rotation. Spray at 7-day intervals. Maneb, 3 lbs./acre. Zinc ion and Maneb, 3 lbs./acre.

CONTROL OF VEGETABLE DISEASES (Cont.)

Onions (Cont.)	Purple blotch	Fungus on crop residue	Brown to purplish sunken spots on leaves and bulbs. Leaves yellow and die from tip. Bulbs may rot from neck down.	Sanitation: plow under crop residue. Destroy cull piles. Four year rotation. Spray at 7-day intervals. Maneb, 3 lbs./acre. Zinc ion and Maneb, 3 lbs./acre.
Potatoes	Seed piece decay	Bacteria and fungi (soil and seed piece-borne)	Seed pieces decay. Missing hills. Plants stunted. Leaves rolled.	Store seed at 40° F.; warm to 60-70° F. for 1½-2 weeks before planting. Treat with Captan 8%, ½ lb./bu. Captan 8% plus Streptomycin, 100 ppm, ½ lb./bu. Dithane M-45 or Manzate 200, follow manufacturer's directions. Maneb or Maneb plus Streptomycin 100 ppm (dip in 1 lb./10 gal.) Polyram, .11 lb. actual/100 lbs. seed. Zineb or Zineb plus Streptomycin 100 ppm, .15 lb. actual/ 100 lbs. (as a dust) or 1 lb./50 gal. (as a dip).
	Black leg	Bacteria	Plants yellowish, wilted, stunted base of stem may be slimy, black and odorous. Tubers show black, stem-end discoloration.	Plant northern-grown, certified disease-free seed. Warm seed before planting. Plant in warm soil. Seed treatment as for seed-piece decay.
	Scab	Actinomycete	Shallow, rough (raised or pitted), corky scabs or russet on surface of tuber.	Plant resistant varieties. Cherokee, Tawa, Plymouth, Norgold, Norland, Antigo, Superior, etc. Avoid manures and other organic fertilizers. Use acid-forming fertilizer.
	Curly top	Virus (leaf hopper transmitted)	Plants yellowed, stunted, upright. Leaves curled and leathery.	Control leaf hoppers--see Entomology.

CONTROL OF VEGETABLE DISEASES (Cont.)

Potatoes (Cont.)	Early blight	Fungus on crop residue	Brown, targeted spots on leaves.	Spray Bravo 6F, Difolatan 4F (label dosage only), Duter, Fixed coppers (Kocide 101, Tri-basic Copper sulfate, Oxy Cop), Maneb 80 WP, 1½-2 lbs./acre, Maneb plus Zinc ion complex, Polyram. Follow manufacturer's directions.
	Late blight	Fungus on crop residue	Large, water-soaked, dark green to purplish irregular areas on lower leaves, progress upward. Diseased areas dry out and die. Overall appearance of field as if frosted. Bluish-purple blotches on tubers. Rot in storage.	Destroy cull piles and volunteer plants. Spray as for Early Blight.
	Rhizoctonia	Fungus (soil- and tuber-borne)	Dark brown to black scurf on tubers. Brown cankers on lower stem and on stolons.	Certified seed. Soil treatment with Terrachlor EC. Follow manufacturer's directions.
Tomatoes	Bacterial spot, speck	Bacteria on crop residue	Yellowish-green to brown, rusty or black irregular spots on leaves and stems with yellow margins on leaves. Small, scabby, whitish or black spots on fruit.	Four year rotation. Plow under crop residue. Sanitation of equipment (formaldehyde 37% 1:20 with water). Use hot water treated seed (122° F. for 25 minutes). Spray with Fixed coppers--follow label directions.
	Seed rot damping off	Fungus (soil-borne)	Poor stand, seedlings collapsed. Older plants wilted, cankered stem at soil line.	Seed treatment: Captan, Chloranil, Dichlone, Thiram (follow with hot water treatment when seed is dry). Follow label directions.
	Early blight	Fungus on crop residue	Dark brown, targeted spots on leaves and stems. Leaves yellow and fall, causing fruit to sunscald. Dark, sunken spots on stem end of fruit.	Plow under crop residue. Spray at 10 to 12-day intervals starting when first fruit cluster is formed. Bravo 6F, Difolatan (machine harvest only), Fixed Coppers (Cit Cop 4-E, Kocide 101), Maneb, Maneb plus Zinc ion, Polyram. Follow manufacturer's directions.

CONTROL OF VEGETABLE DISEASES (Cont.)

Tomatoes (Cont.)	Septoria leaf spot	Fungus on crop residue	Numerous, small, dark brown spots with grayish centers. Leaves yellow and drop. Fruit small, poor quality. May sunscald.	Plow under crop residue. Spray: same as for Early blight.
	Fusarium wilt, Verticillium wilt	Fungi (soil-borne)	Plants stunted, turn yellow. Wilt starting with lower leaves. Brown streaks in stem and root. Brown cankers may girdle stem near soil line. Roots rotted.	Four year rotation. Plant resistant varieties.
	Blossom end rot	Physiological	Water-soaked turning dark, leathery and sunken, encompassing more or less of the blossom end of the fruit.	Avoid cultivation close to the roots. Maintain even moisture supply--irrigation or mulch.
	Botrytis mold (Greenhouse)	Fungus on crop residue	Water-soaked areas, turn yellow to brown in leaves and elongated cankers on stem. May also cause fruit rot.	Sanitation. Control night humidity. Spray with Bravo, Chlorothalonil, Dithane M-45, or Manzate 200.
	Leaf mold (Greenhouse)	Fungus on crop residue	Circular lesions with golden brown mold on underside of leaf--usually on lower leaves first.	Sanitation. Control night humidity. Spray with Bravo, Maneb, Zinc ion/Maneb, or use Termil smoke generator. Follow manufacturer's directions.